



RQF LEVEL 4



GENCE401 MANUFACTURING TECHNOLOGY

Cost Estimation

TRAINER'S MANUAL

October, 2024



COST ESTIMATION



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ACRONYMS

ASTM: American Society for Testing and Materials

BoM: Bill of Materials

BoQ: Bill of Quantity

CFRP: Carbon Fiber Reinforced Polymer

CNC: Computer Numerical Control

COGS: Calculate Cost of Goods Sold

CR: Neoprene

Frw: Franc Rwandais

GFRP: Glass Fiber Reinforced Polymer

HR: Human Resource

ISO: International Standard Organization

NBR: Nitrile Rubber

NR: Natural Rubber

NT: Number of Tasks completed

PET: Polyethylene Terephthalate

PP: Polypropylene

PS: Polystyrene

PVA: Polyvinyl Acetate

PVC: Polyvinyl Chloride

RFQ: Request for Quotation

RTB: Rwanda TVET Board

TPT: Time Per Task

TT: Total Time

VMQ: Silicone Rubber

VAT: Value-Added Tax

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled "**Cost estimation.**" Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainer's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labour market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer trainees opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that trainees review the key reading and the points to remember section.

MODULE CODE AND TITLE: GENCE401 COST ESTIMATION

Learning Outcome 1: Examine Work

Learning Outcome 2: Determine Required Resources

Learning Outcome 3: Calculate Cost Estimation

Learning Outcome 1: Examine Work



Indicative contents

1.1 Introduction to the Cost Estimation

1.2 Localisation of the Workplace

1.3 Analysing of the Workload of the Work

1.4 Determination of Work Timeline

Key Competencies for Learning Outcome 1: Examine Work

Knowledge	Skills	Attitudes
• Description of cost estimation • Identification of the metrics of measuring the work duration	• Localizing the manufacturing workplace • Conducting manufacturing site visit • Determining the workload through site visit and shape of work. • Applying the metrics of measuring the work duration	• Having ability to pay attention to details while examining manufacturing work • Being critical thinker while examining manufacturing work • Having ability to manage time effectively while examining manufacturing work • Having self-confidence while examining manufacturing work • Having ability to know how to negotiate with others while examining manufacturing work • Being task oriented while examining manufacturing work • Being hard worker while examining manufacturing work



Duration: 10 hrs



Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly the cost estimation as used in cost estimation.
2. Conduct properly the site visit according to the work.
3. Localise properly the workplace in accordance with the type of work.
4. Determine properly the workload or complexity of the work according to the survey findings.
5. Plan accurately the work schedule according to the work complexity.



Resources

Equipment	Tools	Materials
• PPEs (helmet, safety shoes, gloves, face mask, goggles) • Computer	• Pen • Ruler • Tape measure • Calculator	• Paper • Notebook • Pen • Pencil



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail the template of a BoM
- Avail the template of a BoQ
- Prepare the workshop/ site where trainees will visit during the activity
- Avail documents detailing the taxes in Rwanda
- Avail sample documents such as invoice, purchase order, proforma, schedule of rates.



Indicative content 1.1: Introduction to the Cost Estimation



Duration: 2hrs



Theoretical Activity 1.1.1: Description of Cost Estimation



Notes to the trainer:

- While delivering this content, trainer may use small groups to describe the key terms used in cost estimation
- The use of sample documents and templates related to BoQ, BoM and Taxes as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and request trainees to answer the following questions:

- i. What do you understand by the following terms?
 - a) Cost
 - b) Cost estimation
 - c) Specification
 - d) BOM
 - e) Tax
 - f) BOQ
- ii. What could be the objectives of cost estimation

Step 2: Ask trainees to write provided answers on flipchart/paper

Step 3: Engage trainees to present their findings

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Address any questions or concerns.

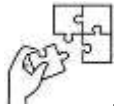
Step 6: Ask trainees to read the key reading 1.1.1. In trainee manual.



Points to Remember

- Always objectives of cost estimation should be considered for the effective bills of quantity
- Make sure that you choose the right types of taxes which applies to your project.

- Always remember that BoM and BoQ are both important in the manufacturing project. No one replaces other



Application of learning 1.1.

Ask your trainees to visit manufacturing workshop of your school by observing how cost estimation of the project has been done by interviewing different manufacturer and make a report detailing what they acquired during the visit.

Checklist for application

SN	Criteria	Indicators	Yes	No
1	Observation of how to estimate the cost is properly done	1.1 BoQ, BoM and taxes' documents are observed		
		1.2. Objectives of cost estimation in manufacturing were identified		
		1.3 New knowledge acquired is mentioned		
		1.4. Visit Report is written		



Indicative content 1.2 and 1.3: Localisation of the workplace and Analysing of the Workload of the Work



Duration: 5 hrs



Practical Activity 1.2.1.and 1.3.1: Determining the Workload of Manufacturing Works



Notes to the trainer

- Facilitation of this activity may be individual based; you are requested to facilitate trainees in determining the Workload of Manufacturing Works.
- As a part of safety, you are requested to avail all safety equipment (PPEs) and measuring tools required during a site visit.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the-activity and ask trainees to make a visit at the new construction site located near the school and determine the workload for the work of supplying 5 doors required on that house, this task should be done individually.
- Step 2:** Explain the task and provide clear work instruction (Task, PPE, Time allocated)
- Step 3:** Facilitate trainees in planning and making site visit and determining the workload.
- Step 4:** Verify whether the site visit and determination of the workload are correctly done.
- Step 5:** Ask trainees to read key reading 1.2.1 and 1.3.1
- Step 6:** Ask trainees to perform the task provided in application of learning 1.2 and 1.3.



Points to Remember

- Remember to request the permission to the concern before making site visit to avoid conflicts.
- When analysing workload of the manufacturing work, you have always to make site visit



Application of learning 1.2 and 1.3.

There is a house which is going to be constructed near your school, the owner wants an employee to determine the workload of manufacturing activities of fabricating doors and windows of that house. Ask your trainees to:

- Make a site visit
- Determine the workload of fabricating doors and windows

Checklist for application

SN	Criteria	Indicators	Yes	No
1	site visit is well conducted	1.1. Steps for Planning and Making a Manufacturing Site Visit are respected		
		1.2 Data from site visit are recorded		
2	workload is determined	2.1. Procedures of assessing the shape of work are respected		
		2.2 dimensions are correctly taken		
		2.3 appropriate tools are used		



Indicative content 1.4: Determination of Work Timeline



Duration: 3 hrs



Practical Activity 1.4.1: Calculating Work Timeline for Manufacturing

Activities



Notes to the trainer

- Facilitation of this activity may be individual based; you are requested to facilitate trainees on calculating work timeline.
- You are requested to avail examples of calculations of the work timeline for effective understanding.



Key steps:

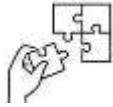
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to determine the work timeline (cycle time, lead time and takt time) for the project of fabricating 10 mild steel door frames of 90 cm*210 cm (length and height respectively).
- Step 2:** Explain the task and provide clear work instruction (Task, PPE, Time allocated)
- Step 3:** Explain the procedures of calculating cycle time, lead time and takt time.
- Step 4:** Facilitate trainees in calculating cycle time, lead time and takt time.
- Step 5:** Verify whether the calculated cycle time, lead time and takt time is correctly done.
- Step 6:** Ask trainees to read key reading 1.4.1.
- Step 7:** Ask trainees to solve the question provided in application of learning 1.4



Points to Remember

- When determining the appropriate time for the completion of the project, never take too long to bother the customers nor too short to fail delivering



Application of learning 1.4.

The manufacturing workshop of the school was granted to produce automotive components. The school management wants a manufacturing technician to analyse the production process to ensure that it meets the required customer demand. Having the data as follows, ask your trainees to calculate:

1. Cycle Time
2. Lead Time
3. Takt Time

Data:

- Customer Demand: 1,000 units per week
- Operating Time per Day: 8 hours
- Number of Working Days per Week: 5 days
- Total Units Produced per Day: 200 units
- Total Time Spent on Production per Day: 6 hours
- Order Request Date: Monday, 9:00 AM
- Order Delivery Date: Wednesday, 5:00 PM

Solution:

- 1. Cycle Time = Total Time Spent on Production per Day / Total Units Produced per Day / 3 marks**

Cycle Time = 6 hours / 200 units = 0.03 hours/unit or 1.8 minutes/unit

- 2. Lead Time = Order Delivery Date – Order Request Date / 3 marks**

Order Request Date: Monday, 9:00 AM

Order Delivery Date: Wednesday, 5:00 PM

Calculating the time between these dates:

From Monday 9:00 AM to Tuesday 9:00 AM: 24 hours

From Tuesday 9:00 AM to Wednesday 9:00 AM: 24 hours

From Wednesday 9:00 AM to Wednesday 5:00 PM: 8 hours

Lead Time = 24 hours + 24 hours + 8 hours = 56 hours

- 3. Takt Time = Possible Production Hours / Customer Demand of Units / 4 marks**

Possible Production Hours = 8 hours/day × 5 days/week = 40 hours/week

Customer Demand of Units = 1,000 units/week

Takt Time = 40 hours/week / 1,000 units/week = 0.04 hours/unit or 2.4 minutes/unit

Final Answers:

1. **Cycle Time:** 1.8 minutes per unit
2. **Lead Time:** 56 hour
3. **Takt Time:** 2.4 minutes per unit



Learning outcome 1 end assessment

Written assessment

1. Read carefully the following questions related to cost estimation and circle the letter corresponding to the right answer.

- i. Which of the following best defines cost estimation?
- a. The process of calculating taxes required for a project.
 - b. The process of forecasting the financial and other resources needed to complete a project within a defined scope.
 - c. A list of materials required to complete a project.
 - d. The documentation of labor hours worked on a project.

Answer: b) The process of forecasting the financial and other resources needed to complete a project within a defined scope.

- ii. What is the primary purpose of a Bill of Materials (BOM) in cost estimation?
- a. To list and quantify the labor required for a project.
 - b. To provide a comprehensive list of taxes applicable to a project.
 - c. To outline the project schedule and deadlines.
 - d. To provide a detailed list of parts, materials, and components needed to create a product.

Answer: d) To provide a detailed list of parts, materials, and components needed to create a product.

- iii. What is one primary purpose of conducting a site visit when analyzing manufacturing workload?
- a. To observe the aesthetics of the final product.
 - b. To understand the physical layout, infrastructure, and environmental conditions of the site.
 - c. To meet with suppliers and negotiate material costs.
 - d. To collect customer feedback on product design.

Answer: b) To understand the physical layout, infrastructure, and environmental conditions of the site.

- iv. How does the "shape of work" influence manufacturing processes?
- a. It determines the marketing strategy for the product.
 - b. It dictates the color and branding of the final product.
 - c. It impacts the choice of machining or forming processes required to shape the material.
 - d. It has no significant impact on the manufacturing process.

Answer: c) It impacts the choice of machining or forming processes required to shape the material.

v. Which metric in a manufacturing process measures the time it takes to produce a single unit, focusing solely on the manufacturing portion?

- A) Lead Time
- B) Cycle Time
- C) Takt Time

Answer: B) Cycle Time

vi. What does Lead Time measure in a manufacturing process?

- A) The rate at which products need to be produced to meet customer demand
- B) The time it takes to produce a single unit
- C) The total time from order placement to delivery, encompassing all stages of production

Answer: C) The total time from order placement to delivery, encompassing all stages of production

vii. Takt Time in a manufacturing process is used to:

- A) Identify areas where production time can be reduced
- B) Align production pace with customer demand to avoid overproduction or underproduction
- C) Measure the total time from order placement to delivery

Answer: B) Align production pace with customer demand to avoid overproduction or underproduction

2. Complete the following sentences related to importance of cost estimation using the following words (**budget, resource allocation , project planning, risk management, financial constraints**) and write the answer in the empty space

I. Accurate cost estimation is crucial in project management because it ensures that a project is completed within its

Answer: financial constraints

II. Accurate cost estimates allow organizations to create realistic preventing project delays or the need for additional funding.

Answer: budget

3. Observe carefully the following table and match the following terms in column C with their correct definitions in column B and provide answers in column A

Column A: Answers	Column B: Definitions	Column C: Terms
1.....	1. The time it takes to produce one unit of a product.	A. Localization of the manufacturing workplace
2.....	2. Adapting manufacturing operations and costs	B. Workshop

	to a specific location.	
3.....	3. A dedicated space for manufacturing processes.	C. Manufacturing site
4.....	4. A physical location for large-scale production.	D. Takt time
5.....	5. The available production time per unit of customer demand.	E. Cycle time F. mean time G. total time

Answers:

Answers
1....E
2.....A
3.....B
4.....C
5.....D

4. Read carefully the following statements related to cost estimation and answer by **True** for the correct statements or **False** for the incorrect statements

a) Takt time is the total time it takes to complete one unit of production.

Answer: False

b) Labor costs are a factor to consider when localizing manufacturing.

Answer: True

c) A workshop is typically larger than a manufacturing site.

Answer: False

d) Lead time is the same as cycle time.

Answer: False

e) Localization involves assessing local regulations and their impact on costs.

Answer: True

f) Determining work duration in a manufacturing setting is crucial for constructing a project schedule because it helps project managers estimate the time each activity will take to complete.

Answer: True

g) Understanding task time and total time in a manufacturing project is insignificant for identifying potential bottlenecks and optimizing workflows.

Answer: False

Practical assessment

Precision Tech is a company known for producing high-quality mechanical components for the automotive industry. Ask trainees to ensure on-time delivery of 1,000 specialized components for a major automotive client.

Their tasks are:

1. To conduct a Site Visit
2. Analyze the workload
3. Break down the production process into individual tasks
4. measure the time required for each task
5. Calculate Key Metrics:
 - Cycle Time
 - Lead Time
 - Takt Time
6. Make a report

Performance check list

Criteria	Indicator	Observation		Comments
		Yes	No	
1.workload Analysis is well done	Ind 1. Site visit is done			
	Ind 2. Shape of work is analysed			
	Ind 3. Workload is determined			
2.Cycle Time Calculation is well performed	Ind 1. cycle time formula is correctly used			
	Ind 2. cycle time per unit is determined			
3.Lead Time Calculation is well performed	Ind 1. the lead time formula is correctly used			
	Ind 2. calculation of the lead time is done			
4.Takt Time Calculation is well performed	Ind1. takt time formula is correctly used			
	Ind 2. takt time is accurately calculated			
5.Report and Presentation is well done	Ind 1. findings are presented			
	Ind 2. recommendations are presented			



Further information to the trainer

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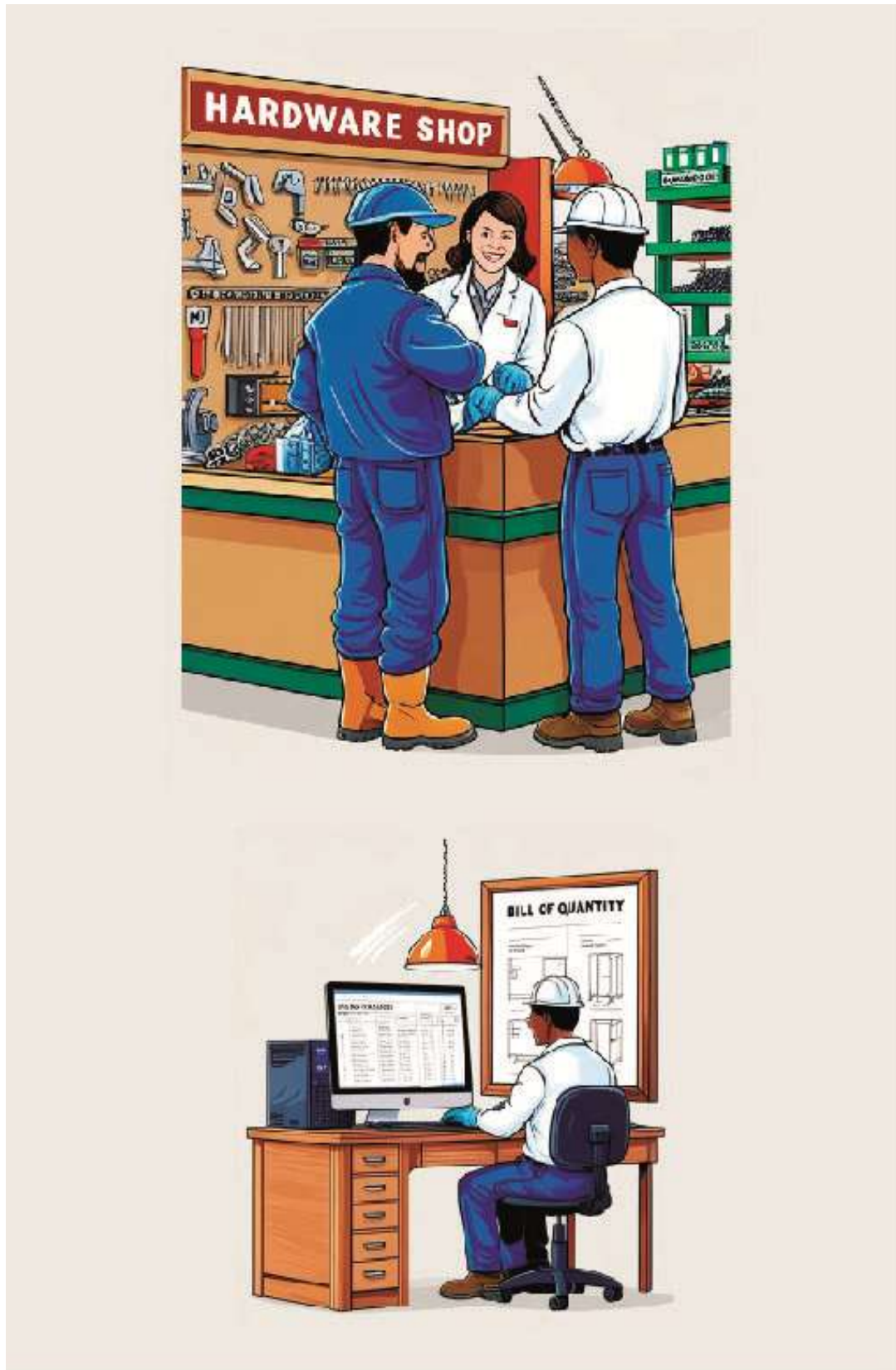
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Learning Outcome 2: Determine Required Resources



Indicative contents

2.1 Identifying tools and Equipment

2.2 Elaborating bill of material

2.3 Determining Human Resources

Key Competencies for Learning Outcome 2: Determine Required Resources

Knowledge	Skills	Attitudes
• Identification of specifications and costs of available tools and Equipment for a manufacturing work • Identification of manufacturing equipment consumption • Description of material specifications for a manufacturing work • Identification of elements of a manufacturing bill of material • Identification of the qualification levels of the workers in manufacturing field	• Preparing the manufacturing BoM • Calculating the quantities and cost of materials of manufacturing work • Determining the number of required workers for a manufacturing work • Calculating the time spent on a manufacturing task	• Having the ability of Paying attention to details while determining the required resources for a manufacturing work • Being critical thinker while determining the required resources for a manufacturing work • Having the ability of Managing time effectively while determining the required resources for a manufacturing work • Being a manufacturing task oriented • Being manufacturing hard worker • Being updated to the new manufacturing technology

		• Being updated to the costs of manufacturing materials, tools and equipment on market • Having a sharpen mind while determining the required resources for a manufacturing work
--	--	---



Duration: 15 hrs



Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify properly the tools and equipment according work requirements
2. Elaborate properly the material specifications according to the need
3. Determine properly the quantities of materials according to the drawing
4. Prepare effectively a Bill of Materials in accordance with the nature of the manufacturing work
5. Determine properly the cost of materials according to the drawing
6. Determine properly the human resources according to the required skills
7. Calculate correctly the time spent on a manufacturing task according to the nature of the work



Resources

Equipment	Tools	Materials
• Computer • Camera	• Ruler • Calculator	• Paper • Notebook • Pen • Schedule of rates • Drawings



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail the template of a manufacturing BoM
- Avail a schedule of current rates for manufacturing materials
- Avail a catalogue/user manual of some manufacturing tools/equipment



Indicative content 2.1: Identifying Tools and Equipment



Duration: 5 hrs



Theoretical Activity 2.1.1: Identification of Tools and Equipment for Manufacturing Works



Notes to the trainer:

- While delivering this content, trainer may use small groups for identifying tools and equipment for manufacturing works
- The use of templates related to BoM, as didactic materials is required.
- The use of sample user manuals for the manufacturing tools/equipment as didactic materials is required.



Key steps:

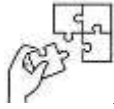
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and request trainees to answer the following question:
- i. How can you differentiate tools from equipment?
 - ii. What could be the general specifications of manufacturing tools equipment?
 - iii. How can you identify the cost of tools and equipment?
- Step 2:** Ask trainees to write provided answers on flipchart/paper
- Step 3:** Engage trainees to present their findings
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 2.1.1. In trainee manual.



Points to Remember

- Do not forget to read the user manual of tools and equipment to help you to identify the quality tool and quality equipment. Always check the specifications on the user manual before deciding the right tool
- It is necessary to consider the cost of the tool/ equipment but when it comes to the quality and productivity, do not focus on the cost but consider the quality and productivity (the lower the price of tool/equipment, the lower the quality)



Application of learning 2.1.

There is a manufacturing workshop in your school having a store of the tools/equipment used in manufacturing. Ask your trainees to visit the manufacturing workshop and consult the user manuals of tools/equipment to acquire more knowledge about:

- The available tools and equipment
- The specifications of tools and equipment
- The cost of tools and equipment
- The consumption of equipment

Allow them to ask questions to the workshop manager where necessary for more understanding and ask them to make a report detailing what acquired as new knowledge during the visit

Checklist for application

SN	Criteria	Indicators	Yes	No
1	The user manual is consulted	1.1 the available tools and equipment are identified		
		1.2 the specifications of tools and equipment are identified on user manual		
		1.3 the cost of tools and equipment are identified on user manual		
		1.4. the consumption of the equipment is identified on user manual		
		1.5 observations are presented in the report		



Indicative content 2.2: Elaborating Bill of Material



Duration: 5 hrs



Theoretical Activity 2.2.1: Description of Bill of Material



Notes to the trainer:

- While delivering this content, trainer may use small groups for describing the material specifications and the elements of Bill of Materials.
- The use of templates of BoM as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and request trainees to answer the following question:

- What do you understand by the term “material specifications”?
- What could be the general elements which included in the material specifications?
- What could be the common properties of manufacturing materials that you know?
- What could be the elements which included in a manufacturing bill of material?

Step 2: Ask trainees to write provided answers on flipchart/paper

Step 3: Engage trainees to present their findings

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 2.2.1. In trainee manual.



Points to Remember

- It is essential to consider the material properties before its use. Because these properties help determine how a material will perform under different conditions



Practical Activity 2.2.2: Elaborating a Manufacturing Bill of Material



Notes to the trainer

- The Facilitation of this activity may be individual based, referring to the previous activity 2.2.1 trainer is requested to facilitate trainees on elaboration of a BoM.
- As a part of preparation, trainer is requested to avail BoM template and schedule of current rates of materials



Key steps:

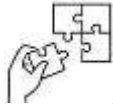
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to elaborate a Bill of Materials for a manufacturing work of a Welding Table with the following assumptions: Table dimensions: 1000mm x 500mm, Table height: 750mm, Table top material: 10mm thick steel plate, Frame material: 50x50mm square steel tubing, Legs: 40x40mm square steel tubing
- Step 2:** Explain the task and provide clear work instruction (Task, Time allocated)
- Step 3:** Facilitate trainees in elaborating a Bill of Materials for a manufacturing work of a Welding Table
- Step 4:** Verify whether the Bill of Materials for a manufacturing work of a Welding Table is correctly elaborated
- Step 5:** Ask trainees to read key reading 2.2.2. and to ask for clarification where necessary.
- Step 6:** Ask trainees to perform the task provided in application of learning 2.2.



Points to Remember

- Remember to verify that the quantity of each part is correct, accounting for any possible waste or scrap.
- Ensure that units of measure are standardized and consistent throughout the document.
- Break down the product into assemblies, subassemblies, and components for minimising confusion



Application of learning 2.2.

The school wants to manufacture mountain bike frames for the school bicycle club. in order to manufacture mountain bike frames, referring to the activity 2.2.2, Ask your trainees to elaborate a complete Bill of Materials (BOM) for the mountain bike frame by considering the following specifications:

- Frame Material: Aluminum alloy
- Frame Size: Medium
- Frame Weight: Approximately 2.5 kg
- Tube Thickness: 1.5 mm
- Head Tube Angle: 68 degrees
- Seat Tube Angle: 74 degrees

Based on these specifications, ask your trainees to develop a detailed Bill of Materials (BOM) that includes all components, materials, and quantities required for the manufacturing of the mountain bike frame.

Solution

Item No.	Part Name	Part Number	Material	Quantity	Unit of Measure	Description/Specification
1	Main Frame Tube	MTB-001	Aluminum Alloy 6061	1	Piece	Ovalized top tube, 45 cm length
2	Down Tube	MTB-002	Aluminum Alloy 6061	1	Piece	Double-buttet down tube, 55 cm length
3	Seat Tube	MTB-003	Aluminum Alloy 6061	1	Piece	Reinforced seat tube, 35 cm length
4	Chainstay (Left & Right)	MTB-004	Aluminum Alloy 6061	2	Piece	Hydroformed chainstay, 35 cm length
5	Seat Stay (Left & Right)	MTB-005	Aluminum Alloy 6061	2	Piece	Seat stay with disc brake mount
6	Bottom Bracket Shell	MTB-006	Aluminum Alloy 6061	1	Piece	Threaded bottom bracket shell, BSA standard
7	Head Tube	MTB-007	Aluminum Alloy 6061	1	Piece	Tapered head tube, 44mm upper, 56mm lower
8	Dropouts (Left & Right)	MTB-008	Aluminum Alloy 6061	2	Piece	Replaceable derailleur hanger included
9	Cable Guide	MTB-009	Nylon	5	Piece	Internal cable routing guides
10	Welding Material	-	ER4043 Aluminum Rod	-	Kg	Welding material for frame joints
11	Paint and Coating	-	Powder Coating	-	Kg	Durable outdoor paint, UV resistant
12	Decals	MTB-010	Vinyl	1	Set	Custom school logo and branding decals



Indicative content 2.3: Determining Human Resources



Duration: 5 hrs



Practical Activity 2.3.1: Determining Human Resources



Notes to the trainer

- The Facilitation of this activity may be individual based, trainer is requested to facilitate trainees on determination of the number of workers and the time spent on a task
- As a part of preparation, trainer is requested to avail examples of manufacturing projects for helping trainees to determine the number of workers and time per tasks



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce activity and ask trainees to calculate the number of workers and time per task for a project of manufacturing 1,000 units of a product that requires 500 hours of work and you want it done in 20 days. Consider 8 hours per day per worker
- Step 2:** Explain the task and provide clear work instruction (Task, Time allocated)
- Step 3:** Facilitate trainees in determining the number of workers and the time spent on a tasks
- Step 4:** Verify whether the number of workers and the time spent on a task are correctly determined
- Step 5:** Ask trainees to read key reading 2.3.1. and to ask for clarification where necessary.
- Step 6:** Ask trainees to solve the question provided in application of learning 2.3.



Points to Remember

- Every manufacturing project require many workers of different categories. Remember that each category of worker is able to perform well his/her own specific task in a project depending on his/her qualification level. Do not ignore anyone.

- All works are not of the same complexity. Analyse the complexity of the project before calculating the number of workers, and consider the level of complexity in your calculations
- For better calculating the time per task, it is advised to analyse the project and make a breakdown of single tasks.



Application of learning 2.3.

The school workshop is launching a new product, an automotive metal parts. The production team needs to determine the optimal workforce and production time to meet the initial order of 1000 parts within a 20-day timeframe.

- Standard working hours per day = 8 hours
- Estimated time for each task per part:
 - ✓ Cutting: 0.15 hours/part
 - ✓ Welding: 0.25 hours/part
 - ✓ Finishing: 0.10 hours/part

Ask your trainees to determine the number of workers required for each task, to calculate the total time spent on each task and to calculate the Time Per Task (TPT) for each task.

Solution:

Determining the Number of Workers:

- **Total Work Hours: /3 marks**
 - Cutting: $1000 \text{ parts} * 0.15 \text{ hours/part} = 150 \text{ hours}$
 - Welding: $1000 \text{ parts} * 0.25 \text{ hours/part} = 250 \text{ hours}$
 - Finishing: $1000 \text{ parts} * 0.10 \text{ hours/part} = 100 \text{ hours}$
- **Total Available Work Hours: /1 marks**
 - $8 \text{ hours/day} * 20 \text{ days} = 160 \text{ hours/worker}$
- **Number of Workers Required: /2 marks**
 - Cutting: $150 \text{ hours} / 160 \text{ hours/worker} = 0.94 \text{ workers (round up to 1 worker)}$
 - Welding: $250 \text{ hours} / 160 \text{ hours/worker} = 1.56 \text{ workers (round up to 2 workers)}$
 - Finishing: $100 \text{ hours} / 160 \text{ hours/worker} = 0.63 \text{ workers (round up to 1 worker)}$

Calculating Total Time Spent on Each Task: /2 marks

- Already calculated above:
 - Cutting: 150 hours
 - Welding: 250 hours
 - Finishing: 100 hours

Calculating Time Per Task (TPT): /2 marks

- Cutting: $TPT = 150 \text{ hours} / 1000 \text{ parts} = 0.15 \text{ hours/part}$
- Welding: $TPT = 250 \text{ hours} / 1000 \text{ parts} = 0.25 \text{ hours/part}$
- Finishing: $TPT = 100 \text{ hours} / 1000 \text{ parts} = 0.10 \text{ hours/part}$

Conclusion:

- The manufacturing process requires 1 worker for cutting, 2 workers for welding, and 1 worker for finishing.
- The total time spent on cutting is 150 hours, on welding is 250 hours, and on finishing is 100 hours.
- The Time Per Task (TPT) for cutting is 0.15 hours/part, for welding is 0.25 hours/part, and for finishing is 0.10 hours/part



Learning outcome 2 end assessment

Written assessment

1. Read carefully the following questions related to cost estimation and circle the letter corresponding to the correct answer:

i. Which of the following is NOT a common specification for manufacturing tools?

- A. Tool Material
- B. Tool Geometry
- C. Cutting Speed and Feed Rate
- D. Assembly Line System

Answer: D) Assembly Line System

ii. Which factor does NOT typically influence the cost of manufacturing equipment?

- A. Size and Capacity
- B. Materials and Construction
- C. Employee Training Costs
- D. Automation and Technology

Answer: C) Employee Training Costs

iii. Which of the following materials is known for its high electrical conductivity and is commonly used in electrical wiring?

- A. Steel
- B. Aluminum
- C. Copper
- D. Polyethylene

Answer: c) Copper

iv. Which material property describes the ability of a material to withstand applied forces without deformation or failure?

- A. Elasticity
- B. Strength
- C. Thermal Conductivity
- D. Hardness

Answer: b) Strength

v. Which of the following is NOT a typical component of a Bill of Materials (BOM)?

- A. Part number
- B. Quantity
- C. Marketing strategy
- D. Description

Answer: C. Marketing strategy

vi. What is the primary purpose of assigning BOM levels?

- A. To categorize components based on their size.
- B. To determine the order of assembly for the product.

- C. To calculate the total cost of the product.
- D. To identify critical components.

Answer: B. To determine the order of assembly for the product.

- vii. Which of the following is the first step in determining human resources during cost estimation?
 - A. Estimate Work Effort
 - B. Identify Roles and Responsibilities
 - C. Allocate Resources
 - D. Calculate Labor Costs

Answer: b) Identify Roles and Responsibilities

- viii. What should be considered in addition to direct labor costs when determining total labor costs?
 - A. Work Effort
 - B. Hourly Rates or Salaries
 - C. Indirect Costs
 - D. Resource Allocation

Answer: c) Indirect Costs

2. Read carefully the following statements related to cost estimation and Answer by **True** for the correct statements or **False** for the incorrect statements

- i. The availability of manufacturing equipment is largely unaffected by global events such as trade disputes or pandemics.

Answer: False

- ii. Surface finish in manufacturing is only concerned with the appearance of a material, not its performance.

Answer: False

- iii. The material composition in manufacturing can vary greatly depending on the type of product being manufactured and its intended use.

Answer: True

- iv. Material Safety Data Sheets (MSDS) are used to provide information on safe handling, storage, and disposal of materials in a BOM.

Answer: True

- v. A Bill of Materials (BOM) should only include information about physical components, not subassemblies.

Answer: False

- vi. It is essential to review and validate the BOM before initiating the manufacturing process.

Answer: True

- vii. The cost of each component should be included in the BOM for effective cost management.

Answer: True

viii. Efficiency impacts the number of workers required for a task because it influences how much work each worker can complete within a given time frame.

Answer: True

ix. If workers are operating at 100% efficiency, more workers will be needed to complete the same amount of work.

Answer: False

x. To account for variations in efficiency, the effective work capacity of each worker can be calculated by multiplying the nominal work capacity by the efficiency rate.

Answer: True

3. the following table contains 3 columns. Match the column C (qualification level) with its correct description in column B. type the letter corresponding to the right answer in column A

Column A. Answer	Column B. Description	Column C. Qualification Level
1.....	1) Experienced professionals with advanced skills	A) Entry-Level
2.....	2) Employees with minimal experience	B) Intermediate-Level
3.....	3) Employees with some experience and moderate skills	C) Senior-Level
4.....	4) Experts in specific fields or disciplines	D) Specialists E) trainer F) technician

Answer:

1.....C

2.....A

3.....B

4.....D

4. complete the following sentence using one of the following words (**fewer workers, many workers, specialized workers, unskilled workers**)

When determining the number of workers needed for a project, it is important to consider the complexity of the task because more complex tasks often require

Answer: specialized skills

5. Complete the table below to calculate the Average Time Per Task (TPT) in a manufacturing setting

Step	Description	Value
1	Total time spent on completing tasks (TT)	200 hrs
2	Number of tasks completed (NT)	50 hrs
3	Average Time Per Task (TPT) calculation	
4	Average Time Per Task (TPT)	

Answer:

Step	Description	Value
1	Total time spent on completing tasks (TT)	200 hrs
2	Number of tasks completed (NT)	50 hrs
3	Average Time Per Task (TPT) calculation	TPT = TT / NT
4	Average Time Per Task (TPT)	4 hours/task

Practical assessment

"Evergreen Cycles" is a medium-sized bicycle manufacturing company specializing in producing high-quality mountain bikes. Your trainees have been engaged as a Manufacturing Technician at "Evergreen Cycles." Ask them to prepare a comprehensive Bill of Materials (BOM) for the new bike frame and to calculate the necessary number of workers for the assembly line

Data Provided:

- Production Target: 100 bike frames per day
- Assembly Process Breakdown:
 - ✓ Welding: 1 hour per frame
 - ✓ Painting: 1.5 hours per frame
 - ✓ Assembly: 2 hours per frame
 - ✓ Quality Control: 0.5 hours per frame
- Available Work Hours per Worker per Shift: 8 hours
- Shifts per Day: 2 shifts

Performance checklist

Element	Indicator	Observation		Comments
		YES	NO	
1. BOM is well prepared	Ind.1. All components are listed			
	Ind.2. Quantities are accurate			
	Ind.3. Unit costs are included			
	Ind.4. Total costs are calculated			
	Ind.5. Recommended vendors are listed			
2. Workers are calculated	Ind.1. Time per frame is calculated			
	Ind.2. Total worker hours needed are correct			
	Ind.3. Number of workers per task is accurate			
	Ind.4. Shift planning is completed			
	Ind.5. Worker allocation is optimal			



Further information to the trainer

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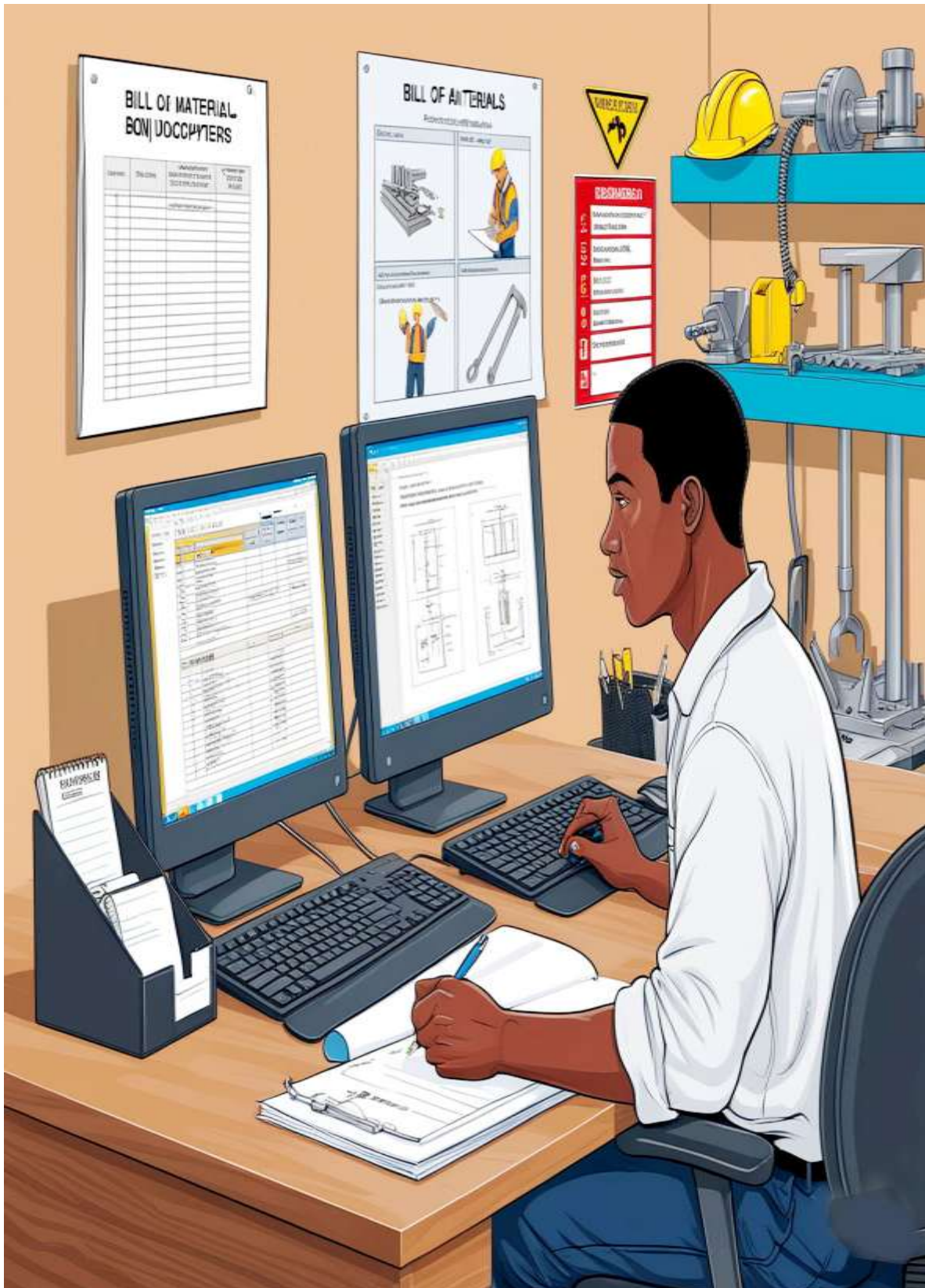
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Learning Outcome 3: Calculate Cost Estimation



Indicative contents
3.1 Conducting price survey
3.2 Determining costs
3.3 Calculating benefits and charges
3.4 Elaborating Bill of Quantity

Key Competencies for Learning Outcome 3: Calculate Cost Estimation

Knowledge	Skills	Attitudes
• Description of techniques of price survey during cost estimation • Description of benefits and charges during cost estimation • Identification of elements of bill of quantity during cost estimation	• Conducting price survey during cost estimation • Applying mathematical operations during cost estimation • Determining costs during cost estimation • Applying formulas of calculating benefits and charges during cost estimation • calculating benefits and charges during cost estimation • Interpreting the drawings of elements during cost estimation • Applying measurements of figures during cost estimation • Elaborating of Bill of Quantity during cost estimation	• Being honest in estimating the cost • Having ability of negotiating with others during estimation of cost • Having self-confidence for enhancing decision-making • Being critical thinker when estimating the cost of project • Being task oriented during cost estimation • Being hard worker during cost estimation • Having ability of paying attention to details for ensuring all cost factors



Duration: 15 hrs



Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly the techniques of price survey according to the work requirements
2. Describe properly the benefits and charges according to the work requirements
3. Identify properly the elements of bill of quantity as used in cost estimation
4. Apply correctly relevant mathematical operations as used in cost estimation
5. Determine correctly both direct and indirect costs according to the price survey done.
6. Interpret correctly technical drawings or plans according to the work requirements
7. Use precisely the measurements from drawings and plans according to the work requirements
8. Conduct properly the price survey in accordance with the project requirements and quality of materials.
9. Determine correctly the project costs according to the project specification and price survey done.
10. Apply properly standard formulas for calculating benefits and charges according to the cost consideration
11. Calculate precisely the benefits and charges according to the cost consideration.
12. Elaborate correctly the Bill of Quantity according to the project requirements.



Resources

Equipment	Tools	Materials
• Computer • Printer	• Scientific calculator • Pen • Ruler	• Paper

	• Tape measure	
 Advance Preparation: Before delivering this learning outcome, you are recommended to: • Avail the project drawings and specifications • Avail the current rates of the required items • Avail the template of a BoQ • Have an organized classroom with a computer and a printer		



Indicative content 3.1: Conducting Price Survey



Duration: 4hrs



Theoretical Activity 3.1.1: Description of Techniques for Conducting Price Survey



Notes to the trainer:

- While delivering this content, trainer may use small groups for describing of techniques for conducting price survey
- The use of sample of a proforma invoice as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Step 1: Introduce the activity and request trainees to answer the following question:
- What do you understand by a conducting price survey?
 - What could be the main methods of conducting price survey?
- Step 2:** Ask trainee to write provided answers on flipchart/paper.
- Step 3:** Engage trainees in presentation of their findings.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 3.1.1. In trainee manual.



Points to Remember

- When drawing the proforma invoice, always make a survey of the current price for the different suppliers of the materials at the market because rates may change every day and differ.
- When drawing the proforma, make sure you take accurate measurements and correct calculations of the quantities.



Practical Activity 3.1.2: Drawing the proforma invoice



Notes to the trainer

- The Facilitation of this activity may be individual based, referring to the previous activity 3.1.1 trainer is requested to facilitate trainees drawing the proforma invoice.
- As a part of preparation; trainer is requested to Provide trainees with case studies where they must create a proforma invoice from start to finish.



Key steps:

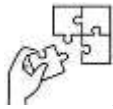
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to draw the proforma invoice by applying measurements and calculations of a mild steel tube window frame of 1m to 1m.
- Step 2:** Explain the task and provide clear work instruction (Task and Time allocated)
- Step 3:** Demonstrate how to draw the proforma invoice. While demonstrating, explain the general procedures to follow when drawing proforma invoice template.
- Step 4:** Facilitate trainees in drawing proforma invoice.
- Step 5:** Verify whether drawing the proforma invoice is correctly done.
- Step 6:** Ask trainees to read key reading 3.1.2., and ask for clarification where necessary.
- Step 7:** Ask trainees to perform the task provided in application of learning 3.1.



Points to Remember

- When drawing the proforma invoice, always make a survey of the current price for the different suppliers of the materials at the market because rates may change every day and differ.
- When drawing the proforma, make sure you take accurate measurements and correct calculations of the quantities.



Application of learning 3.1.

Your school production unit won a tender to supply construction materials for a major project. As part of the initial steps, the school requires a detailed proforma invoice to be prepared, which will outline all the materials required for the project, along with their costs. Ask trainee to:

- Draft a proforma invoice based on the details provided
- Use the template provided and completes the invoice within the three hours.
- Make sure to include all the essential materials

Checklist for application

Element	Indicator	Observation		Comments
		yes	No	
Invoice template is well prepared	Ind.1.Template is prepared			
	Ind 2. Template includes necessary sections			
The Invoice is filled out	Ind.1.Company details are accurately entered			
	Ind.2.Client details are correctly entered			
	Ind.3.All materials are listed with precise descriptions			
	Ind.4.Costs per unit are accurately entered			
	Ind. 5.Subtotal, taxes, and final total are calculated correctly			
Invoice has been reviewed and proofread	Ind.1.Invoice is reviewed for errors			
	Ind.2.Figures and descriptions match project requirements			
	Ind. 3.All sections of the invoice are completed and clearly presented			
The final steps are well completed	Ind.1.Document reflects company's professionalism			
	Ind.2.Invoice is saved in required format			
The invoice has been Submitted.	Ind.1.Invoice is submitted within the specified timeframe			
	Ind.2.Copy of the invoice is retained for records			



Indicative content 3.2: Determining Costs



Duration: 4hrs



Practical Activity 3.2.1: Determining Cost



Notes to the trainer

- The Facilitation of this activity may be individual based, trainer is requested to facilitate trainees on determining the cost.
- As a part of preparation; trainer is requested to Provide trainees with the examples where they must calculate the cost.



Key steps:

While delivering this activity, pass through the following steps:

Introduce the activity and ask trainees to determine the cost of a manufacturing project of fabricating mild steel window frame of 1*1 m

Step 2: Explain the task sheet and provide clear work instruction

Step 3: Demonstrate how to determine the cost.

Step 4: Facilitate trainees to determine the cost.

Step 5: Verify whether determining the cost is done correctly.

Step 6: Ask trainees to read key reading 3.2.1., and ask for clarification where necessary.

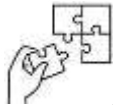
Step 7: Ask trainees to solve the question provided in application of learning 3.2.



Points to Remember

- Ensure you have all relevant data before starting cost calculation, including the cost of materials, labor, overheads (both variable and fixed), and the selling price per unit.
- Review all calculations to ensure accuracy. Small mistakes can lead to significant errors in the final outcome.

- Keep detailed notes on how each figure was calculated, including any assumptions made. This will be useful for future reference or for explaining the results to others.



Application of learning 3.2.

Your school workshop is a well-known manufacturer of bricks moulds, is currently focused on calculating the costs associated with their production process. Having the following expense details, ask your trainees to calculate the total cost of manufacturing the bricks mould

- Raw Materials: Rwf 300,000 covers the cost of essential materials required to manufacture the bricks,
- Direct Labour: Rwf 80,000 the wages paid to workers directly involved in the brick-making process.
- Factory Rent: Rwf 15,000 the cost of renting the space where the bricks are produced.
- Power: Rwf 5,000 is the electricity costs needed to run the machinery and equipment. Supervisor's Salaries: Rwf 20,000 the compensation paid to supervisors who oversee the production line.
- Administration Expenses: Rwf 40,000 are costs related to the administrative operations supporting the manufacturing process and
- Selling and Distribution Expenses: Rwf 15,000 is the costs involved in bringing the finished bricks to the market.

Solution:

Direct material.....300 000

Direct wages.....80 000

Prime cost..... 380 000 / 2marks

Factory overheads:

Factory rent15 000

Power..... 5 000

Supervision..... 20 000 40 000

Cost of goods manufactured.....420 000 / 2marks

Administration overheads.....40 000

Selling and distribution overheads.....15 000

Total cost of sales.....475 000/ 2marks



Indicative content 3.3: Calculating Benefits and Charges



Duration: 4hrs



Practical Activity 3.3.1: Calculating Benefits and Charges



Notes to the trainer

- The Facilitation of this activity may be individual based, trainer is requested to facilitate trainees calculating the benefit.
- As a part of preparation; trainer is requested to Provide trainees with case studies where they must calculate the Gross profit and Net profit of a project.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to calculate the Gross profit and Net profit of a company with Revenue: RWF100, 000, COGS: RWF40, 000, Operating Expenses: RWF25, 000 and Other Expenses (including Taxes): RWF10, 000.

Step 2: Demonstrate how to calculate Gross profit and Net profit.

Step 3: Facilitate trainees to calculate the benefits.

Step 4: Verify whether the calculations are done correctly.

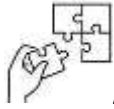
Step 5: Ask trainees to read key reading 3.3.1

Step 6: Ask trainees to solve the question provided in application of learning 3.3.



Points to Remember

- Ensure that all figures for revenue, COGS, operating expenses, and other costs are accurate and up-to-date.
- Compare your gross and net profits with industry benchmarks or competitors to assess your operational efficiency and competitiveness.



Application of learning 3.3.

Having the following data, Ask your trainees to calculate the gross profit and net profit.

- ✓ Revenue: RWF200, 000
- ✓ COGS: RWF80, 000
- ✓ Operating Expenses: RWF50, 000
- ✓ Other Expenses (including Taxes): RWF20, 000

Solution:

Gross Profit=RWF200, 000–RWF80, 000=RWF120, 000 **/2marks**

Net Profit=RWF120, 000–RWF50, 000–RWF20, 000=RWF50, 000**/2marks**



Indicative content 3.4: Elaborating Bill of Quantity



Duration: 3 hrs



Practical Activity 3.4.1: Elaborating Bill of Quantity



Notes to the trainer

- The Facilitation of this activity may be individual based, trainer is requested to facilitate trainees to elaborate a bill of quantity
- As a part of preparation, trainer is requested to Provide trainees with the example of full project data where they must elaborate a bill of quantity.



Key steps:

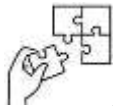
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to fill the bill of quantity by applying measurements and calculations of a mild steel tube window frame of 1m to 1m.
- Step 2:** Explain the task and provide clear work instruction (Task and Time allocated)
- Step 3:** Demonstrate how to fill the bill of quantity. While demonstrating, explain the general procedures to follow when filling in a BOQ template.
- Step 4:** Facilitate trainees in filling the bill of quantity.
- Step 5:** Verify whether filling the bill of quantity is done correctly.
- Step 6:** Ask trainees to read key reading 3.4.1., and ask for clarification where necessary.
- Step 7:** Ask trainees to perform the task provided in application of learning 3.4.



Points to Remember

- When filling the BoQ, always make a survey of the current rates of the materials at the market because rates may change every day
- When filling the BoQ, make sure you take accurate measurements and correct calculations of the quantities
- Always remember to include the taxes for avoiding penalties



Application of learning 3.4.

The school production unit won a tender to fabricate doors for a new apartment complex being constructed. The school needs a detailed Bill of Quantity (BOQ) to accurately assess the materials, labor, and costs involved in the project. Ask your trainees to elaborate the Bill of Quantity for the required doors

The drawings, specifications, and other related documents necessary for the BOQ are found in the manufacturing workshop of the school

Checklist for application

Element	Indicator	Observation	
		Yes	No
BOQ is elaborated	The materials are listed		
	Quantities are completed.		
	Labor requirements are determined		
	Cost is estimated		
	Benefit and charges are determined		



Learning outcome 3 end assessment

Written assessment

1. Read carefully the following questions related to cost estimation and circle the letter corresponding to the right answer.

answer.

i. What is the best step in planning a price survey for a manufacturing business?

- A) Identifying target competitors
- B) Setting a budget for the survey
- C) Designing the survey questionnaire
- D) Defining the objectives of the survey

Answer: D) Defining the objectives of the survey

ii. Which of the following is the most effective method for collecting pricing data in a price survey?

- A) Phone interviews
- B) Online surveys
- C) Field observation
- D) Analyzing publicly available reports

Answer: C) Field observation

iii. Which of the following is the best describes Gross Profit?

- A) Total revenue minus all operating expenses
- B) Total revenue minus the cost of goods sold (COGS)
- C) Total revenue minus all taxes and interest
- D) Total revenue minus both operating expenses and taxes

Answer: B) Total revenue minus the cost of goods sold (COGS)

iv. What does Net Profit is represent?

- A) The total revenue of a company
- B) The profit made before accounting for operating expenses
- C) The profit made after deducting all expenses, including taxes and interest
- D) The profit made after deducting only the cost of goods sold

Answer: C) The profit made after deducting all expenses, including taxes and interest

v. Gross Profit is used to measure:

- A) A company's overall profitability after all expenses
- B) The efficiency of production and pricing strategies
- C) The impact of taxes on company profits
- D) Cash flow from operating activities

Answer: B) The efficiency of production and pricing strategies

2. Read carefully the following statements related to cost estimation and Answer by **True** for the correct statements or **False** for the incorrect statements

- i. The Bill of Quantities (BOQ) is primarily used to estimate the cost of materials and labor for a construction project. **TRUE**
- ii. "Measured Works" in a BOQ refers to the description and quantification of all items of work to be completed in a project. **TRUE**
- iii. The "Contingencies" section in a BOQ is included to cover unforeseen expenses that may arise during the project. **TRUE**
- iv. The Bill of Quantities only includes costs related to labor and excludes materials and other resources. **FALSE**

3. The following table contains 3 columns. Match the column B (benefits and charges) with the column C (elements of BOQ) and type the letter corresponding to the right answer in the column A

Column A. Answer	Column B. Benefits	Column C. Elements of BOQ
A.....	A) Enhanced product durability	1) Machinery and Equipment
B.....	B) Improved product quality and efficiency	2) Overheads
C.....	C) Increased production speed and volume	3) Material
D.....	D) Controlled production costs	4) Taxes and Compliance
E.....	E) Avoids legal penalties and fines	5) Labor
		6) cost
		7) manufacturing site

ANSWER

- A) Enhanced product durability-----3) Material
B) Improved product quality and efficiency-----5) Labor
C) Increased production speed and volume-----1) Machinery and Equipment
D) Controlled production costs-----2) Overheads
E) Avoids legal penalties and fines-----4) Taxes and Compliance

Practical assessment

Suppose your trainees are a cost estimator for XYZ Company that manufactures doors and windows. The company has received an order to produce 100 wooden doors and 200 aluminium windows.

Ask your trainees to estimate the cost of manufacturing and prepare a Bill of Quantities (BoQ) using the following information:

1. Materials:

Wood (for doors):	Quantity per door: 2.5 square meters, Cost per square meter: 24,000RWF
Aluminum (for windows):	Quantity per window: 1.5 square meters, Cost per square meter: 36,000RWF
Glass (for windows):	Quantity per window: 1 square meter, Cost per square meter: 18,000RWF
Hardware (hinges, locks, etc.):	Cost per door: 12,000, Cost per window: 9,800RWF
Paint/Finish:	Cost per door: 6,000RWF, Cost per window: 4,800 RWF

2. Labor Costs: Labor hours per door: 3 hours, Labor hours per window: 2 hours ,Labor cost per hour: 30,000RWF

3. Overheads: Factory overheads per door: 18,000 RWF, Factory overheads per window: 15,000RWF

4. Profit Margin: Desired profit margin: 20%

You are requested to:

1. Calculate the Total Material Cost: Total cost for wood, aluminum, glass, hardware, and paint/finish.
 2. Calculate the Total Labor Cost: Total labor cost for manufacturing doors and windows.
 3. Calculate the Total Overheads: Total overheads for doors and windows.
 4. Calculate the Total Manufacturing Cost: Sum of material, labor, and overhead costs.
 5. Apply the Profit Margin: Calculate the final selling price including the desired profit margin.
 6. Prepare the Bill of Quantities (BoQ): List all items (materials, labor, and overheads) along with their quantities and costs.
- VAT 18% is included

Solution

1. Calculate the Total Material Cost

Wood (for doors): /2marks

- Quantity per door: 2.5 square meters
- Cost per square meter: 24,000 RWF
- Total quantity for 100 doors: $2.5 \text{ m}^2/\text{door} * 100 \text{ doors} = 250 \text{ m}^2$
- Total cost for wood: $250 \text{ m}^2 * 24,000 \text{ RWF/m}^2 = 6,000,000 \text{ RWF}$

Aluminium (for windows): /2marks

- Quantity per window: 1.5 square meters
- Cost per square meter: 36,000 RWF
- Total quantity for 200 windows: $1.5 \text{ m}^2/\text{window} * 200 \text{ windows} = 300 \text{ m}^2$
- Total cost for aluminium: $300 \text{ m}^2 * 36,000 \text{ RWF/m}^2 = 10,800,000 \text{ RWF}$

Glass (for windows): /2marks

- Quantity per window: 1 square meter
- Cost per square meter: 18,000 RWF
- Total quantity for 200 windows: $1 \text{ m}^2/\text{window} * 200 \text{ windows} = 200 \text{ m}^2$
- Total cost for glass: $200 \text{ m}^2 * 18,000 \text{ RWF/m}^2 = 3,600,000 \text{ RWF}$

Hardware (hinges, locks, etc.): /2marks

- Cost per door: 12,000 RWF
- Cost per window: 9,800 RWF
- Total cost for 100 doors: $12,000 \text{ RWF/door} * 100 \text{ doors} = 1,200,000 \text{ RWF}$
- Total cost for 200 windows: $9,800 \text{ RWF/window} * 200 \text{ windows} = 1,960,000 \text{ RWF}$

Paint/Finish: /2marks

- Cost per door: 6,000 RWF
- Cost per window: 4,800 RWF
- Total cost for 100 doors: $6,000 \text{ RWF/door} * 100 \text{ doors} = 600,000 \text{ RWF}$
- Total cost for 200 windows: $4,800 \text{ RWF/window} * 200 \text{ windows} = 960,000 \text{ RWF}$

Total Material Cost: /2marks

- Total cost for wood: 6,000,000 RWF
- Total cost for aluminium: 10,800,000 RWF
- Total cost for glass: 3,600,000 RWF

- Total cost for hardware: 3,160,000 RWF (1,200,000 RWF for doors + 1,960,000 RWF for windows)
- Total cost for paint/finish: 1,560,000 RWF (600,000 RWF for doors + 960,000 RWF for windows)

Total Material Cost = 6,000,000 RWF + 10,800,000 RWF + 3,600,000 RWF + 3,160,000 RWF + 1,560,000 RWF = 25,120,000 RWF

2. Calculate the Total Labor Cost

Labor hours per door: /2marks

- 3 hours per door * 100 doors = 300 hours **Labor hours per window:**
- 2 hours per window * 200 windows = 400 hours **Total Labor Hours:**
- Total labor hours: 300 hours (for doors) + 400 hours (for windows) = 700 hours **Labor Cost per Hour:**
- 30,000 RWF/hour **Total Labor Cost:**
- Total labor cost: 700 hours * 30,000 RWF/hour = 21,000,000 RWF

3. Calculate the Total Overheads

Overheads per door: /2marks

- 18,000 RWF/door * 100 doors = 1,800,000 RWF **Overheads per window:**
- 15,000 RWF/window * 200 windows = 3,000,000 RWF **Total Overheads:**
- Total overheads: 1,800,000 RWF (for doors) + 3,000,000 RWF (for windows) = 4,800,000 RWF

4. Calculate the Total Manufacturing Cost

Total Manufacturing Cost: /2marks

- Total Material Cost + Total Labor Cost + Total Overheads
- Total Manufacturing Cost = 25,120,000 RWF (materials) + 21,000,000 RWF (labor) + 4,800,000 RWF (overheads)
- Total Manufacturing Cost = 50,920,000 RWF

5. Apply the Profit Margin

Profit Margin: /2marks

- Desired profit margin: 20% **Final Selling Price:**
- Final Selling Price = Total Manufacturing Cost * (1 + Profit Margin)
- Final Selling Price = 50,920,000 RWF * (1 + 0.2)
- Final Selling Price = 50,920,000 RWF * 1.2
- Final Selling Price = 61,104,000 RWF

6. Prepare the bill of quantity/10 marks

Item	Quantity	Unit cost(RWF)	Total cost (RWF)
Materials			
Wood (doors)	250 m ²	24,000 RWF/m ²	6,000,000 RWF
Aluminium (windows)	300 m ²	36,000 RWF/m ²	10,800,000 RWF
Glass (windows)	200 m ²	18,000 RWF/m ²	3,600,000 RWF
Hardware (doors)	100 units	12,000 RWF/door	1,200,000 RWF
Hardware (windows)	200 units	9,800 RWF/window	1,960,000 RWF
Paint/Finish (doors)	100 units	6,000 RWF/door	600,000 RWF
Paint/Finish (windows)	200 units	4,800 RWF/window	960,000 RWF
Labor			
Labor (doors)	300 hours	30,000 RWF/hour	9,000,000 RWF
Labor (windows)	400 hours	30,000 RWF/hour	12,000,000 RWF
Overheads			
Overheads (doors)	100 units	18,000 RWF/door	1,800,000 RWF
Overheads (windows)	200 units	15,000 RWF/window	3,000,000 RWF
Total Cost			50,920,000 RWF
Profit (20%)			10,184,000 RWF
Final Selling Price			61,104,000 RWF
VAT rate 18%			10,977,120 RWF
Final Selling Price			72,081,120 RWF

Summary

- Final Selling Price Before VAT: 61,104,000 RWF
- VAT Amount (18%): 10,977,120 RWF
- Final Selling Price Including VAT: 72,081,120 RWF



Further information to the trainer

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